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BAKER (MICHAEL) JR INC BEAVER PA
NATIONAL DAM INSPECTION PROGRAM. COAL DAM (NDI NUMBER PA 00464)--ETC(U)
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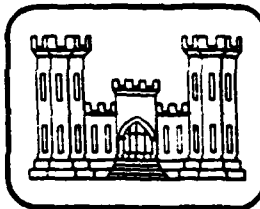
OHIO RIVER BASIN
TRIBUTARY OF BRUSH CREEK, WESTMORELAND COUNTY
PENNSYLVANIA

COAL DAM

NDI No. PA 00464
PennDER No. 65-45

LEVEL

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



prepared for

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

prepared by
MICHAEL BAKER, JR., INC.

Consulting Engineers
4301 Dutch Ridge Road
Beaver, Pennsylvania 15009

May 1980

MICHAEL BAKER, JR., INC.

DACW31-80-C-0025

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OHIO RIVER BASIN

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COAL DAM
WESTMORELAND COUNTY, COMMONWEALTH OF PENNSYLVANIA

NDI No. PA 00464

PennDER No. 65-45

Tributary of Brush

Creek, Westmoreland County, Pennsylvania.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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Prepared for: DEPARTMENT OF THE ARMY
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Baltimore, Maryland 21203

Prepared by: MICHAEL BAKER, JR., INC.
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Beaver, Pennsylvania 15009

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PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Coal Dam, Westmoreland County, Pennsylvania
NDI No. PA 00464, PennDER No. 65-45
Tributary of Brush Creek
Inspected 14 December 1979

ASSESSMENT OF
GENERAL CONDITIONS

Coal Dam is classified as a ~~High~~ hazard - ~~Small~~ size dam. The dam was found to be in fair overall condition at the time of inspection.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway will pass approximately 23 percent of the Probable Maximum Flood (PMF) before overtopping will occur. A spillway design flood (SDF) in the range of the 1/2 Probable Maximum Flood (1/2 PMF) to the PMF is required for Coal Dam. Because of the relatively small size of the impoundment and drainage area the 1/2 PMF was chosen as the SDF. It was determined that during the 1/2 PMF the embankment would be overtopped by a maximum depth of 0.64 foot and a total duration of 4.00 hours. Because the estimated limiting criteria of one foot or greater depth of overtopping and a duration of 2 hours was not exceeded for this dam, it was concluded that a dam failure during the 1/2 PMF is unlikely to occur. Therefore, the spillway is considered ~~inadequate~~ but not ~~seriously inadequate~~. It is recommended that the owner immediately initiate an engineering study to further evaluate the spillway capacity and develop recommendations for remedial measures to reduce the overtopping potential of the dam. ←

The inspection and review of information revealed certain items of work which should be performed without delay by the owner. Items 1 and 2 should be completed under the direction of a qualified professional engineer experienced in the design of earth embankments and appurtenant structures. These include:

- 1) The owner should immediately initiate an engineering study to further evaluate the spillway capacity and develop recommendations for remedial measures to reduce the overtopping potential of the dam.
- 2) Fill the two level areas (depressions) on the downstream slope of the dam and monitor these areas in future inspections to determine if additional remedial work is necessary.

COAL DAM

- 3) Fill the animal/rodent burrows in the embankment.
- 4) Remove the small trees and shrubs from the dam.
- 5) Remove the debris and trees from the discharge channel of the spillway.
- 6) An upstream closure (i.e. gate valve) for the outlet pipe should be installed to protect the embankment in the event of a pipe rupture and for periodic inspection and maintenance of the pipe.
- 7) The brick weir in the spillway should be removed.
- 8) The erosion around the discharge end of the outlet conduit should be repaired and riprap installed to deter future erosion.

In addition, the following operational measures are recommended to be undertaken by the owner:

- 1) Develop a detailed emergency operation and warning system.
- 2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.
- 3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records be developed and implemented.

COAL DAM



Submitted by:

MICHAEL BAKER, JR., INC.

John A. Dziubek
John A. Dziubek, P.E.
Engineering Manager-Geotechnical

Date: 8 May 1980

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 23 May 1980

COAL DAM



Overall View Along the Crest of the Dam from the Right Abutment



Overall View Along the Crest of the Dam from the Left Abutment

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
COAL DAM
NDI No. PA 00464, PennDER No. 65-45

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.
- b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances - Coal Dam is an earthfill embankment approximately 495 feet long. The height of the dam is 31.3 feet, measured from the minimum crest elevation to the toe of the embankment. The upstream face of the dam has a 4.5H:1V (Horizontal to Vertical) slope and the slope of the downstream face is 2.5H:1V. The crest width of the embankment is 8.5 feet. A 3 foot wide concrete core wall extends along the centerline of the embankment. It was not possible to determine the actual depth of this core wall since plans for this dam were not available.

The spillway, located on the left abutment of the dam, currently consists of a broad-crested brick weir which has a rounded downstream face. The weir is 40.5 feet wide and 4.25 feet high. The breadth of the weir (parallel to the direction of flow) is 3 feet. A hole approximately 9 feet wide and 1.3 feet high has been broken out of the center of the weir (see Appendix D, sheet 5, for front view). Concrete spillway training walls extend a minimum of 1.6 feet above the crest of the weir.

A concrete rectangular discharge channel extends 24 feet downstream from the crest of the weir. An earth-lined trapezoidal channel extends from the end of the concrete channel to the confluence with outlet conduit channel.

The outlet works for the dam consist of a 24 inch cast-iron pipe located approximately at Station 3+75. The upstream end of this pipe is submerged in the reservoir. Flow through the outlet was originally controlled by a 24 inch gate valve located in an abandoned valve house at the downstream toe of the embankment. This gate valve is now inoperable and has been replaced by a sliding gate which has been attached to the outlet of the pipe. The slide gate is always kept partially open to maintain a continuous flow out of the reservoir.

- b. Location - Coal Dam is located in North Huntingdon Township, Westmoreland County, Pennsylvania, on an unnamed tributary to Brush Creek. The dam is approximately 1800 feet east of Irwin and 11,000 feet west of Jeannette. The coordinates of the dam are N 40° 19.9' and W 79° 41.2'. The dam and reservoir can be located on the USGS 7.5 minute topographic quadrangle, Irwin, Pennsylvania.
- c. Size Classification - The maximum height of the dam is 31.3 feet and the reservoir volume at the top of dam is 39 acre-feet. The dam is therefore in the "Small" size category.
- d. Hazard Classification - Loss of life and moderate economic damage are likely to result from a failure of the dam since there is a machine shop, several warehouses, and a frequently used railroad line located immediately downstream of the dam. The dam is therefore considered to be in the "High" hazard category.
- e. Ownership - The downstream half of the dam is owned by Mr. John Harkobusic, Biddle Road, Irwin, Pennsylvania 15612. The upstream half of the dam and reservoir area are owned by Mr. Clifford B. Taylor, 902 Lincoln Highway, North Versailles, Pennsylvania 15137.
- f. Purpose of Dam - The dam was originally used to supply water to the boiler house for Westmoreland Coal Company. Currently, the dam is used for storm water retention.
- g. Design and Construction History - The dam was designed and built for the Westmoreland Coal Company. No detailed information pertaining to the design or construction history of the dam is available. Minor modifications made to the dam are discussed in detail in Section 2.2.

- h. Normal Operational Procedures - The 24 inch sliding gate valve is typically kept at least partially open by the owners of the dam. This is done to prevent sediment from clogging the outlet pipe and to maintain the pool level at a relatively low elevation. The pool level is usually lower than the spillway crest and only reaches the spillway during periods of heavy rainfall.

1.3 PERTINENT DATA

- a. Drainage Area (square miles) - 0.29
- b. Discharge at Dam Site (c.f.s.) -
Spillway Capacity at Minimum Top
of Dam (El. 955.8 ft. Mean Sea
Level [M.S.L.]) - 188
- c. Elevation (feet above M.S.L.) -
Design Top of Dam - Unknown
Minimum Top of Dam - 955.8
Average Top of Dam - 956.3
Maximum Design Pool - Unknown
Normal Pool¹ - 952.0
Crest of Weir - 955.0
Bottom of Opening Broken
Out of Weir - 952.0
Maximum Tailwater - Unknown
- d. Reservoir (feet) -
Length of Maximum Pool - 710
Length of Normal Pool - 700
- e. Storage (acre-feet) -
Normal Pool (El. 952.0 ft. M.S.L.) - 27
Top of Dam (El. 955.8 ft. M.S.L.) - 39
- f. Reservoir Surface (acres) -
Top of Dam (El. 955.8 ft. M.S.L.) - 3.61
Normal Pool (El. 952.0 ft. M.S.L.) - 2.45

¹Actual pool level fluctuates depending on the amount of rainfall. Normal pool for this report was defined as the opening in the brick weir.

g. Dam -

Type -	Earthfill
Length (feet) -	495
Height (feet) -	31.3
Crest Width (feet) -	8.5
Side Slopes - Upstream -	4.5H:1V
Downstream -	2.5H:1V
Zoning -	No information is available concerning zoning of the embankment.
Impervious Core -	Concrete core wall
Cut-off -	Unknown, the concrete core wall probably extended below original ground level.
Drains -	None

h. Diversion and Regulatory Tunnel - None

i. Spillway -

Type -	Broad-crested weir with a broken out opening 9 feet wide and 1.3 feet high.
Crest Elevation (original weir - feet M.S.L.) -	952.0
Crest Elevation (top of existing weir - feet M.S.L.) -	955.0
Length of Crest Perpendicular of Flow (feet) -	40.5
Width of Crest Parallel to the Direction of Flow (feet) -	3.0
Gates -	None
Upstream Channel -	Concrete, rectangular approach channel.
Downstream Channel -	Concrete, rectangular discharge channel changing to an earth-lined trapezoidal channel 24 feet downstream of the spillway weir.

j. Regulatory Outlet - The outlet works consist of a 24 inch cast-iron pipe controlled by a sliding gate on the outlet of the pipe.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No information regarding who performed the design work for Coal Dam is available. No design or as-built plans could be obtained from the owner or the Pennsylvania Department of Environmental Resources (PennDER).

2.2 CONSTRUCTION

The dam was designed and built for the Westmoreland Coal Company. No detailed information pertaining to the design or construction history of the dam is available. Some information concerning post-construction modifications was obtained from the present owner of the dam. These modifications include the following:

- 1) The original spillway weir was a broad-crested, concrete weir 1.25 feet high. The previous owner of the dam, the Westmoreland Coal Company, raised the height of the weir to 4.25 feet by constructing a broad-crested brick weir over the existing one.
- 2) Approximately 15 years ago (in 1965), the reservoir level was lowered and the 9 foot by 1.3 foot opening currently in the brick weir was broken out by the present owners of the dam. The bottom of this opening is at the level of the original concrete weir. Since this time, the pool level has reportedly been maintained at a low level except when periods of heavy rainfall cause the impoundment to fill.
- 3) After lowering the reservoir level and breaking out the opening in the spillway weir, the owners found that the outlet pipe would become clogged with sediment during periods of low flow. This blockage would prevent the discharge of water from the reservoir until the pool level rose to a height which would create a sufficient pressure head on the intake of the pipe to clear out the accumulated sediment. To remedy this problem, the owners installed a 24 inch sliding gate on the outlet of the pipe as a replacement for the original gate valve which had become inoperable. The sliding gate is kept partially open to prevent sediment from collecting at the intake of the pipe.

2.3 OPERATION

Mr. Clifford B. Taylor and Mr. John Harkobusic are responsible for the operation and maintenance of the dam.

2.4 EVALUATION

- a. Availability - There is no design information, design plans, or as-built plans available for review.
- b. Adequacy - The information collected is adequate for a Phase I Inspection of this dam.
- c. Validity - There is no reason to question the validity of the information available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General - The inspection was performed on 14 December 1979. No unusual weather conditions were experienced and the pool level was approximately 12 feet below the crest of the spillway. The dam and appurtenant structures were found to be in fair overall condition. Noteworthy deficiencies observed during the visual inspection are described in the following paragraphs. The complete visual inspection check list, field sketch, top of dam profile, and typical cross-section are presented in Appendix A.
- b. Dam - The following is a list of obvious deficiencies noted during the visual inspection of the embankment.
 - 1) There are two level-areas (depressions) on the downstream face of the dam; one at Station 2+00 and one at Station 2+50.
 - 2) Several rodent holes were found on both the upstream and downstream slopes of the dam.
 - 3) There is a heavy growth of brush and small trees on the dam, especially on the upstream face and crest.
- c. Appurtenant Structures - The brick addition to the original spillway weir is in poor condition. Some of the bricks have either become loose or have fallen completely out of place. The brick work in the area surrounding the opening broken out of the weir is cracked and may collapse during a high flow through the spillway. Because there is only 0.8 foot of vertical distance between the top of this brick weir and the minimum top of dam elevation, it is recommended that this structure be removed from the spillway, leaving only the original concrete weir. This would provide 3.8 feet of vertical distance between the crest of the weir and the minimum top of dam elevation and increase the spillway capacity.

The earth-lined portion of the spillway discharge channel has several large trees growing in it. There are also several sinkholes, or large voids, which may have been formed from material dumped over the large riprap in the channel.

The area surrounding the outlet pipe on the downstream toe of the dam is eroded. This erosion could eventually undermine the outlet conduit.

- d. Reservoir Area - The slopes of the reservoir are moderately sloped. Most of the area is covered by vegetation and some has been developed into residential areas. Immediately upstream of the reservoir is an area which is currently being filled. Run-off from this area carries a heavy load of suspended sediment into the reservoir. This has resulted in a relatively large accumulation of sediment in the reservoir over the past few years.
- e. Downstream Channel - The downstream channel is mild to moderately sloping. A machine shop, several warehouses, and a railroad line are located within 500 feet of the downstream toe of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal procedures for operating the reservoir or evacuating the downstream area in case of an impending failure of the dam. It is recommended that formal operating and emergency procedures be adapted.

4.2 MAINTENANCE OF DAM

Mr. John Harkobusic and Mr. Clifford Taylor are responsible for the maintenance of the dam. Generally, the maintenance of the dam is considered poor. The development of a more conscientious maintenance program is recommended.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operating facility at Coal Dam is the 24 inch sliding gate located on the downstream end of the outlet pipe. This sliding gate is adjusted periodically to control the flow rate from the reservoir. It is recommended that a formal maintenance schedule be adopted.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system or procedure in the event of an impending catastrophe. Emergency warning procedures should be developed to notify residents downstream.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The maintenance and operational practices followed for Coal Dam are considered to be poor. Efforts should be made by the owners of the dam to ensure that the dam and appurtenances are functional.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data - There is no detailed hydraulic or hydrologic design information available for Coal Dam.
- b. Experience Data - No records of the performance of the dam and spillway during significant flood events is available.
- c. Visual Inspection - There is a low area on the crest of the dam at Station 3+80. This area is only 0.8 foot above the crest of the spillway weir and approximately 0.5 foot below the average crest elevation.

The spillway weir is in poor condition. The original weir was a concrete, broad-crested weir 1.25 feet in height. The previous owners of the dam had increased the height to 4.25 feet by constructing a broad-crested brick weir with a slightly rounded downstream face on top of the existing weir. The current owners of the dam broke out an opening in the brick weir approximately 15 years ago. This opening is 9 feet wide and 1.33 feet high. The bottom of the opening is at the level of the original weir. The remaining portions of the brick weir are in poor condition with many bricks missing and several large cracks running through the brickwork. It is possible that a large flow through the spillway will result in further disintegration and even a major collapse of the brick portion of the weir.

- d. Overtopping Potential - Coal Dam is a "Small" size - "High" hazard dam requiring evaluation for a spillway design flood (SDF) in the range of the 1/2 Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF). Due to the relatively small size of the impoundment and drainage area, the 1/2 PMF was selected as the SDF for Coal Dam.

The hydraulic capacity of the dam, reservoir, and spillway was assessed by utilizing the U.S. Army Corps of Engineers' Flood Hydrograph package, HEC-1 DB. The hydrologic characteristics of the drainage basin, specifically, the Snyder's unit hydrograph parameters, were obtained from a regionalized analysis conducted by the Baltimore District of the U.S. Army Corps of Engineers.

Analysis of the dam and spillway shows that the dam would be overtopped for a total duration of 4.00 hours by a maximum depth of 0.64 foot during the 1/2 PMF event. The spillway, in its current state, is capable of passing approximately 23 percent of the PMF before overtopping begins.

Additional Phase I analysis of the dam and spillway, including HEC-1 DB analysis, indicated that if the brick wall were removed from the spillway, leaving the original broad-crested weir 1.25 feet high, the dam would not be overtopped by the SDF.

- e. Spillway Adequacy - As outlined in the above analysis, the dam would be overtopped by the SDF. The next criteria for determining spillway adequacy requires an estimate of whether the dam will fail during the 1/2 PMF. The following conditions, as well as the overall state of the dam, were estimated as the limiting criteria which are likely to cause failure of the dam.

- 1) Depth of overtopping of 1.0 foot or greater.
- 2) Duration of overtopping in excess of 2.0 hours.

The overtopping analysis of this dam yielded the following values for the 1/2 PMF.

- 1) Depth of overtopping equal to 0.64 foot.
- 2) Duration of overtopping equal to 4.00 hours.

Based upon the limiting criteria stated above, it is estimated that the dam is not likely to fail during the 1/2 PMF.

The spillway is therefore "inadequate" but not "seriously inadequate".

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations - There were no structural inadequacies noted during the visual inspection that cause immediate concern for the structural stability of the dam. The cause of the two local level areas (depressions) on the downstream face could not be determined. It is recommended that these areas be properly filled and observed periodically in the future to determine if they will reoccur.
- b. Design and Construction Data - No design or construction data were available for review. Although it is difficult to assess the structural stability of the embankment without any knowledge of the construction materials and methods, for this particular dam, with a 2.5H:1V (actually just slightly flatter than 2.5H:1V) downstream slope, concrete core wall, and history of satisfactory performance of the 4.5H:1V upstream slope under fluctuating reservoir conditions, and the fact that no indications of instability were observed during the field inspection; further assessments of the stability are not considered necessary for this Phase I Inspection Report. However, it should be pointed out that the Pittsburgh coal has been extensively mined in the area at a depth such that the effects of subsidence may occur at the surface. If future inspections observe signs of distress, seepage, or subsidence which would affect the structural stability of the dam, additional evaluations and corrective measures may become necessary.
- c. Operating Records - No operating records are available. Nothing in the information obtained during the inspection indicates concern relative to the structural stability of the dam.
- d. Post-Construction Changes - No known changes adversely affecting the structural stability have been performed.
- e. Seismic Stability - The dam is located in Seismic Zone 1 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of minor seismic activity. Therefore, further consideration of the seismic stability is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

- a. Safety - Coal Dam was found to be in fair overall condition at the time of inspection. Coal Dam is a "High" hazard - "Small" size dam requiring a spillway capacity in the range of the 1/2 PMF to PMF. The 1/2 PMF was chosen as the SDF. As presented in Section 5, the spillway and reservoir are capable of passing 23 percent of the PMF before overtopping will occur. During the 1/2 PMF, the maximum depth and total duration of overtopping are 0.64 foot and 4.00 hours, respectively. Because a limiting criteria of one foot or greater depth of overtopping and a duration of 2 hours was estimated for this dam, it was estimated that a dam failure during the 1/2 PMF is unlikely to occur. Therefore, the spillway is considered "inadequate" but not "seriously inadequate."

The local level areas (depressions) do not indicate immediate concern for the continued structural stability of the dam. It is recommended that these areas be properly filled and examined in future inspections and their condition recorded.

- b. Adequacy of Information - The observation and measurements made during the visual inspection are considered sufficient for this Phase I Inspection Report.
- c. Urgency - The owner should initiate the action discussed in paragraph 7.2 without delay and immediately initiate the further evaluation discussed in paragraph 7.1.d. below.
- d. Necessity for Additional Data/Evaluation - The hydraulic/hydrologic analysis performed in connection with this Phase I Inspection Report has indicated the need for additional spillway capacity. It is recommended that the owner immediately initiate an engineering study to further evaluate the spillway capacity and develop recommendations for remedial measures to reduce the overtopping potential of the dam.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection revealed certain items of remedial work which should be performed by the owner without delay. Items 1 and 2 below should be completed under the direction of a qualified professional engineer experienced in the design of earth embankments and appurtenant structures. These include:

- 1) The owner should immediately initiate an engineering study to further evaluate the spillway capacity and develop recommendations for remedial measures to reduce the overtopping potential of the dam.
- 2) Fill the two level areas (depressions) on the downstream slope of the dam and monitor these areas in future inspections to determine if additional remedial work is necessary.
- 3) Fill the animal/rodent burrows in the embankment.
- 4) Remove the small trees and shrubs from the dam.
- 5) Remove the debris and trees from the discharge channel of the spillway.
- 6) An upstream closure (i.e. gate valve) for the outlet pipe should be installed to protect the embankment in the event of a pipe rupture and for periodic inspection and maintenance of the pipe.
- 7) The brick weir in the spillway should be removed.
- 8) The erosion around the discharge end of the outlet conduit should be repaired and riprap installed to deter future erosion.

In addition, the following operational measures are recommended to be undertaken by the owner:

- 1) Develop a detailed emergency operation and warning system.
- 2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

- 3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records be developed and implemented.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH,
TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION

Check List
Visual Inspection
Phase 1

Name of Dam Coal Dam County Westmoreland State PA Coordinates Lat. N 40°19.9'

NDI # PA 00464
PennDER # 65-45

Long. W 79°41.2'

Date of Inspection 14 December 1979

Weather Cloudy

Temperature 25° F.

943.4

Pool Elevation at Time of Inspection ft.*

917.9

Tailwater at Time of Inspection ft.*

M.S.L.

*All elevations referenced to crest elevation of brick weir, estimated from USGS Quad Sheet to be El. 955.0 ft. M.S.L.

Inspection Personnel:

Michael Baker, Jr., Inc.:

Wayne D. Lasch
Jeffrey S. Maze
James G. Uliniski

Owner's Representatives:

Mr. Clifford Taylor

Field Review (18 March 1980)

John A. Dziubek
James G. Uliniski

James G. Uliniski Recorder

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: COAL DAM
 NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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LEAKAGE

STRUCTURE TO
 ABUTMENT/EMBANKMENT
 JUNCTIONS

DRAINS

WATER PASSAGES

FOUNDATION

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: COAL DAM
 NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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SURFACE CRACKS
 CONCRETE SURFACES

STRUCTURAL CRACKING

VERTICAL AND HORIZONTAL
 ALIGNMENT

MONOLITH JOINTS

CONSTRUCTION JOINTS

EMBANKMENT

Name of Dam COAL DAM
 NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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SURFACE CRACKS	None observed	
----------------	---------------	--

UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
---	---------------	--

SLOUCHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Two level areas (depressions) were observed on the downstream slope at Station 2+00 and Station 2+50. The area at Station 2+00 was approximately 21 in. deep at the upstream edge. The area at Station 2+50 was approximately 24 in. deep at the upstream edge.	Fill in these areas and visual monitor in the future.
--	---	---

EMBANKMENT

Name of Dam COAL DAM
 NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Visual inspection of the horizontal alignment indicated no problems. The top of dam profile (sheet A-14) shows that there is a low area on the crest at approximate Station 3+80. This area is approximately 0.5 ft. lower than the average top of dam elevation.	
RIPRAP FAILURES	No riprap was used on this embankment.	
RODENT HOLES	Several rodent holes were observed on both the upstream and downstream slopes of the embankment.	The rodent holes should be filled.
VEGETATION	There is a dense growth of small trees and brush on the embankment, especially on the upstream face and crest.	The trees and brush should be removed.

EMBANKMENT

Name of Dam COAL DAM

NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems were observed.	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

Name of Dam: COAL DAMNDI # PA 00464

VISUAL EXAMINATION OF		OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		Could not be observed.	
INTAKE STRUCTURE		The intake structure was submerged at the time of the inspection. No upstream closure is provided.	Upstream closure of the outlet conduit should be installed.
OUTLET STRUCTURE		A 24 in. gate valve located on the downstream slope area is inoperable and has been replaced with a sliding gate at the discharge end of the pipe.	
OUTLET CHANNEL		Erosion is occurring just below the outlet structure and could eventually undermine the outlet conduit.	Reshape the discharge area of the outlet conduit and install riprap to deter future erosion.
EMERGENCY GATE		The slide gate on the end of the conduit could be opened fully if necessary.	

UNGATED SPILLWAY

Name of Dam: COAL DAM
 NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The weir in the spillway has been raised by the installation of a brick weir on top of the original concrete weir. A hole 9 ft. by 1.33 ft. has been broken in this brick weir	The brick weir should be removed.
APPROACH CHANNEL	Rectangular concrete channel in good condition.	
DISCHARGE CHANNEL	Rectangular concrete channel making transition to earthlined trapezoidal channel. Large riprap boulders have been placed in the channel. The boulders in the upstream portion of the channel have been partially covered with earth. The earth has washed into the voids between the boulders and gives the appearance of "sinkholes" at the surface.	No recommended action.
BRIDGE AND PIERS	None	

A-9

GATED SPILLWAY - Not Applicable

Name of Dam: COAL DAM
NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

CONCRETE SILL

APPROACH CHANNEL

DISCHARGE CHANNEL

BRIDGE AND PIERS

GATES AND OPERATION
EQUIPMENT

A-10

INSTRUMENTATION - None

Name of Dam: COAL DAM
NDI # PA 00464

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
--------------------	--------------	----------------------------

MONUMENTATION/SURVEYS

OBSERVATION WELLS

WEIRS

PIEZOMETERS

OTHER

RESERVOIR

Name of Dam: COAL DAM

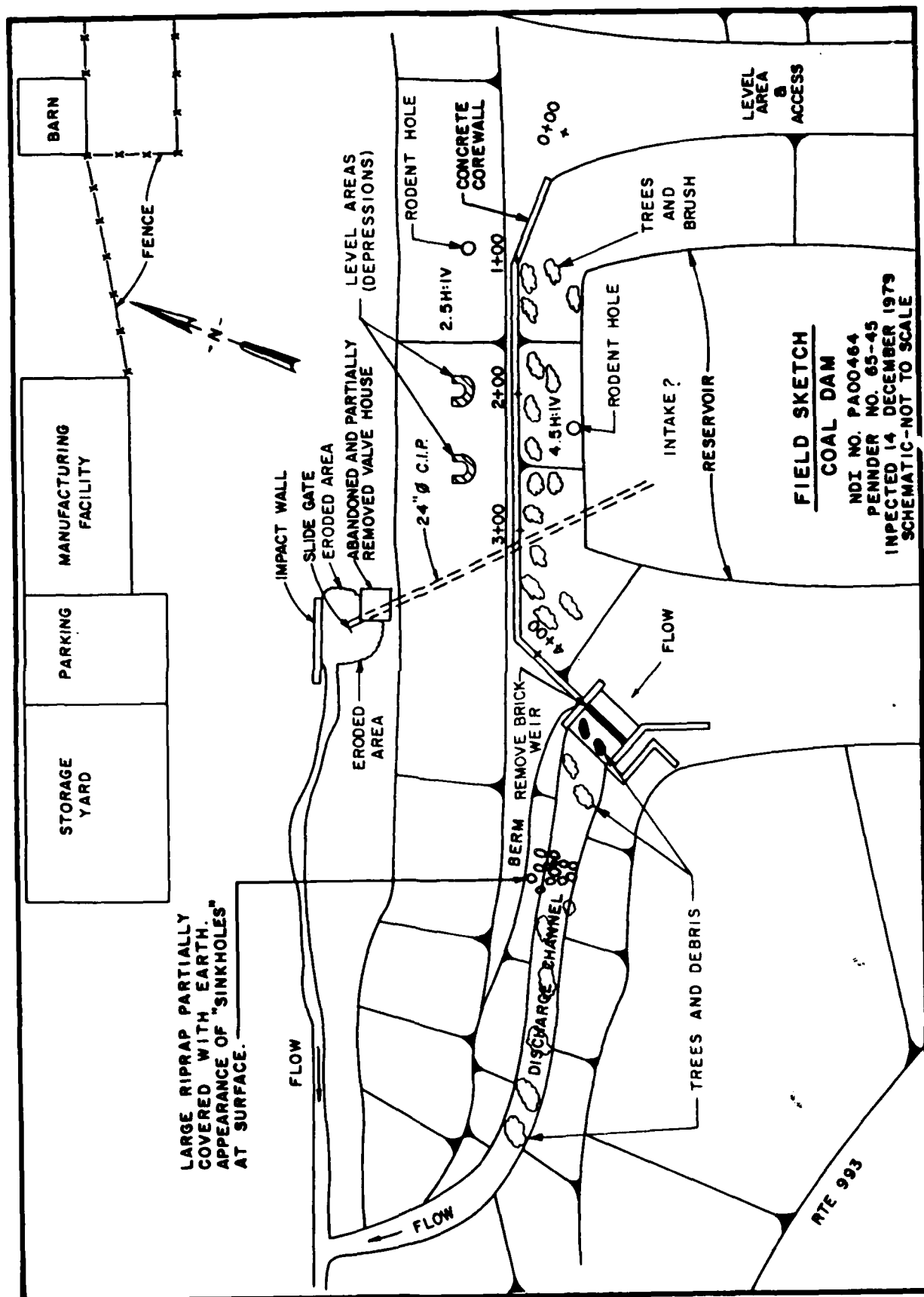
NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes are moderate, covered with woods and residential structures.	
SEDIMENTATION	The reservoir has started to silt up due to dumping of fill material at the upstream end of the lake.	

DOWNSTREAM CHANNEL

Name of Dam: COAL DAM
 NDI # PA 00464

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Several trees are growing in the channel. Several "sinkholes" and some buildup of debris is present in the channel.	The trees and debris should be removed from the channel.
SLOPES	Gentle sloping to moderate sloping fields.	
APPROXIMATE NO. OF HOMES AND POPULATION	No homes are located in the downstream area; however, several warehouses, a machine shop, and railroad tracks are located within the floodplain.	



FIELD SKETCH

COAL DAM

NDI NO. PA00464

PENNER NO. 65-45

INSPECTED 14 DECEMBER 1979

SCHEMATIC-NOT TO SCALE

MICHAEL BAKER, JR., INC.

THE BAKER ENGINEERS

17 March 1980

Box 280

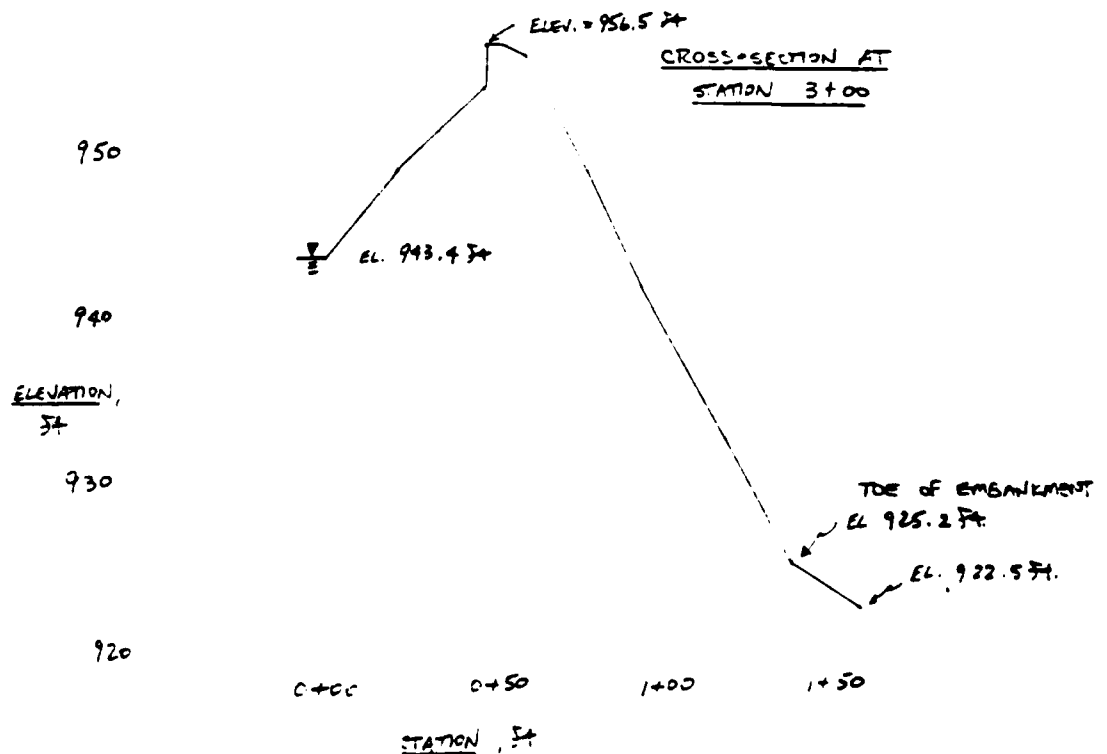
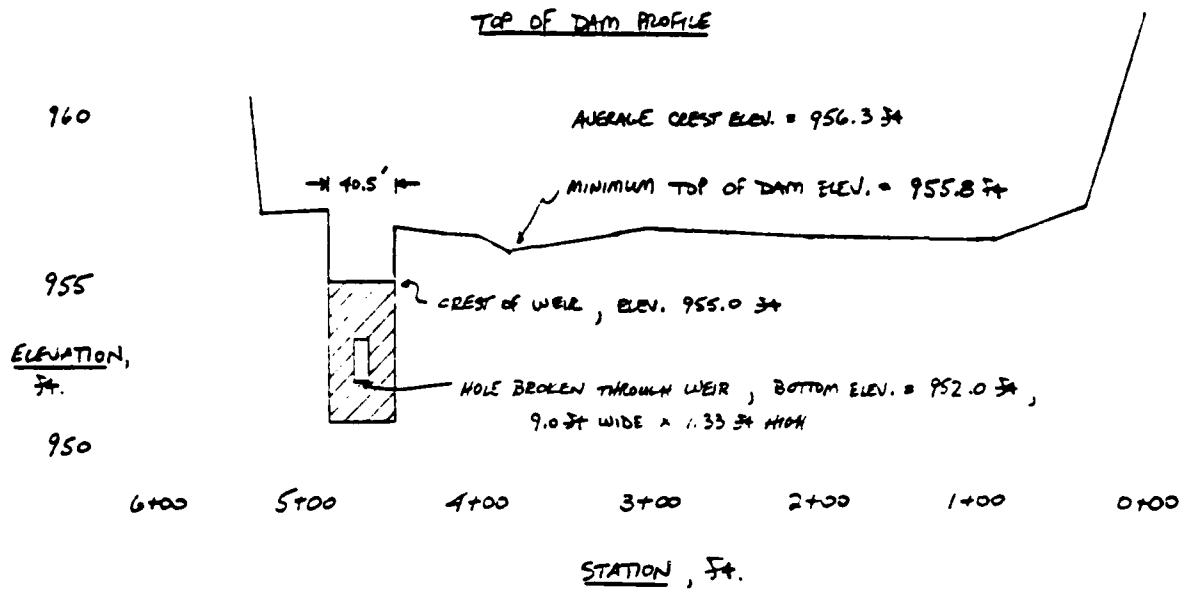
Beaver, Pa. 15009

COAL DAM

TOP OF DAM PROFILE
TYPICAL CROSS-SECTION

Date of Inspection - 14 December 1979

A-14



APPENDIX B

ENGINEERING DATA CHECK LIST

B-1

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: COAL DAM
NDI # PA 00464

ITEM	REMARKS
------	---------

PLAN OF DAM

No plans are available; see Field Sketch for schematic drawing.

REGIONAL VICINITY MAP

A USGS 7.5 minute topographic quadrangle, Irwin, Pennsylvania, was used to prepare the vicinity map which is enclosed in this report as the Location Plan (Plate 1).

CONSTRUCTION HISTORY

The dam was designed and built for the Westmoreland Coal Company. No detailed information pertaining to the design or construction history of the dam is available.

TYPICAL SECTIONS OF DAM

No information available

HYDROLOGIC/HYDRAULIC DATA

No information available

OUTLETS - PLAN

- DETAILS

- CONSTRAINTS

- DISCHARGE RATINGS

No information available

RAINFALL/RESERVOIR RECORDS

No records are kept.

Name of Dam: COAL DAM

NDI # PA 00464

B-2

ITEM

REMARKS

DESIGN REPORTS

No information available

GEOLOGY REPORTS

No information is available. The regional geology is presented as Appendix F of this report.

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIES

No information available

MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD

No information available

POST-CONSTRUCTION SURVEYS OF DAM

None

BORROW SOURCES

No information available

B-3

Name of Dam: COAL DAM
NDI # PA 00464

ITEM	REMARKS
------	---------

MONITORING SYSTEMS

None

MODIFICATIONS

A 4.5 ft. high brick broad-crested weir was added to the spillway by the Westmoreland Coal Co. (date unknown). An opening was broken through this spillway in approximately 1965. A sliding gate valve was installed on the downstream end of the outlet pipe to replace an existing valve which had become inoperable (1965).

HIGH POOL RECORDS

No records kept

POST-CONSTRUCTION ENGINEERING
STUDIES AND REPORTS

None

PRIOR ACCIDENTS OR FAILURE OF DAM
DESCRIPTION
REPORTS

None reported

MAINTENANCE
OPERATION
RECORDS

No formal records are maintained.

B-4

Name of Dam: COAL DAM
NDI # PA 00464

ITEM	REMARKS
------	---------

SPILLWAY PLAN,

SECTIONS,
and
DETAILS

No information available

OPERATING EQUIPMENT
PLANS & DETAILS

No information available

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.29 sq.mi. (medium density residential
with some new development taking place)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 952.0 ft. M.S.L.
(27 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 955.8 ft. M.S.L.
(39 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 955.8 ft. M.S.L. (minimum elevation)

SPILLWAY: _____

- a. Crest Elevation 952.0 ft. M.S.L. (elevation of hole in weir)
- b. Type 9.0 ft. wide by 1.33 ft. high hole in brick broad -
- c. Width of Crest Parallel to Flow 3.0 ft. crested weir
- d. Length of Crest Perpendicular to Flow 40.5 ft.
- e. Location Spillover Left abutment
- f. Number and Type of Gates None

OUTLET WORKS: _____

- a. Type 24 in. diameter C.I.P.
- b. Location Approximate Station 3+00 to 3+75
- c. Entrance Inverts Unknown
- d. Exit Inverts El. 917.3 ft. M.S.L.
- e. Emergency Drawdown Facilities Pipe described above could
serve as drawdown facilities

HYDROMETEOROLOGICAL GAGES: None

- a. Type _____
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE No records available

APPENDIX C

PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

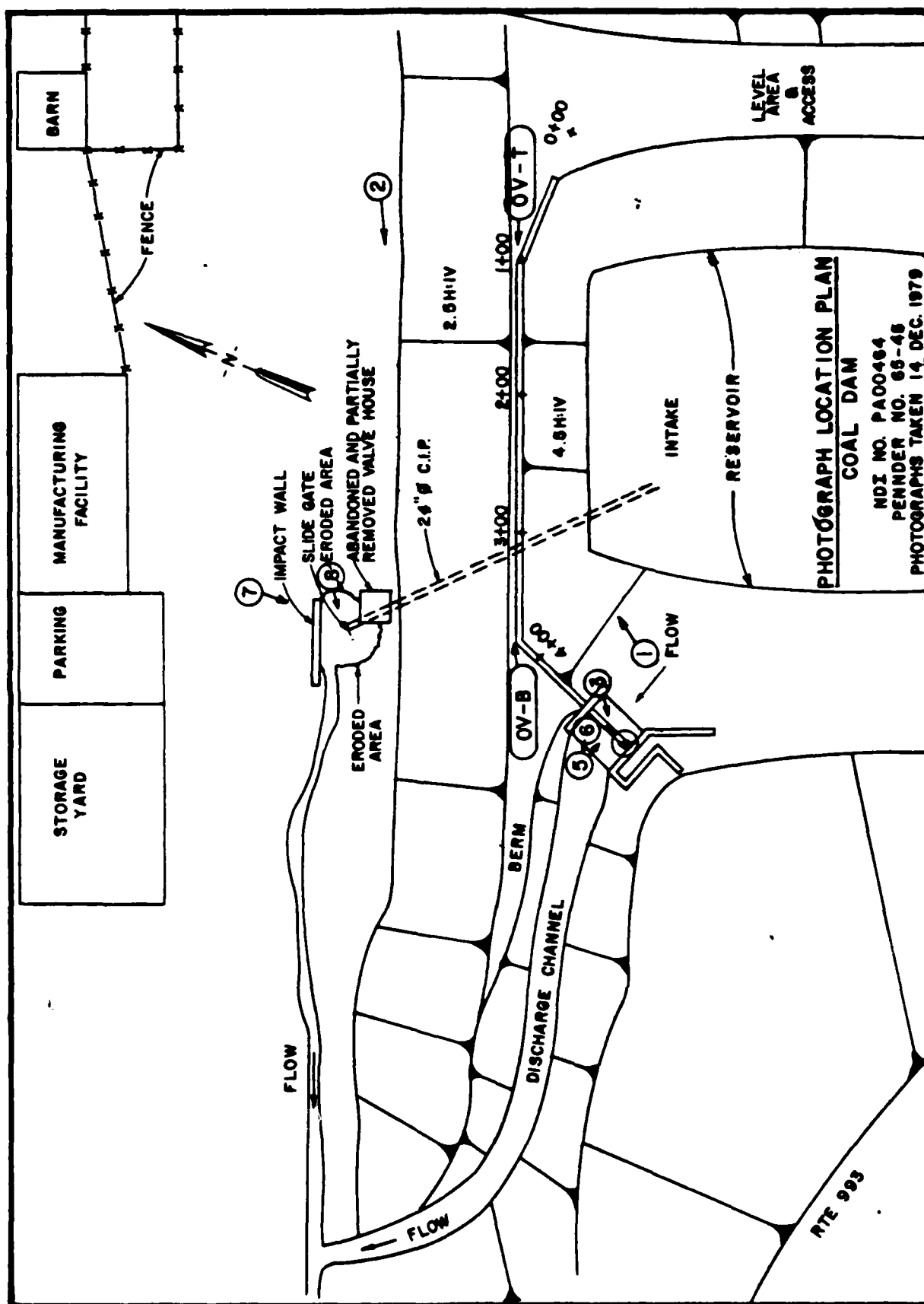
Overall View -

- Top Photo - Overall View Along the Crest of the Dam
(OV-T) from the Right Abutment
- Bottom Photo - Overall View Along the Crest of the Dam
(OV-B) from the Left Abutment

Photograph Location Plan

- Photo 1 - View of the Upstream Slope from the Entrance to the Spillway
- Photo 2 - View of the Downstream Slope from the Right Downstream Toe
- Photo 3 - View of the Upstream Side of the Spillway Weir from the Right Spillway Training Wall
- Photo 4 - View Looking Across the Spillway Weir from the Left Side of the Weir
- Photo 5 - View Looking Upstream at the Downstream Side of the Spillway Weir
- Photo 6 - View Looking Downstream Along the Spillway Discharge Channel
- Photo 7 - View Looking Upstream at the Outlet Location and Abandoned Valve House
- Photo 8 - Close-up View of the Discharge End of the Outlet Conduit with Slide Gate (Note erosion in background of photo)

Note: Photographs were taken on 14 December 1979.



COAL DAM

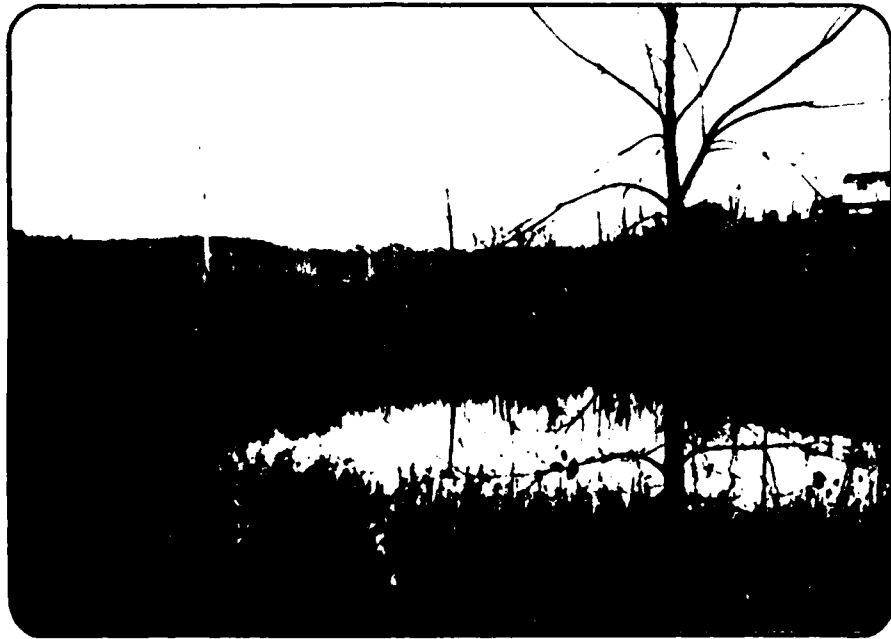


PHOTO 1. View of the Upstream Slope from the Entrance to the Spillway

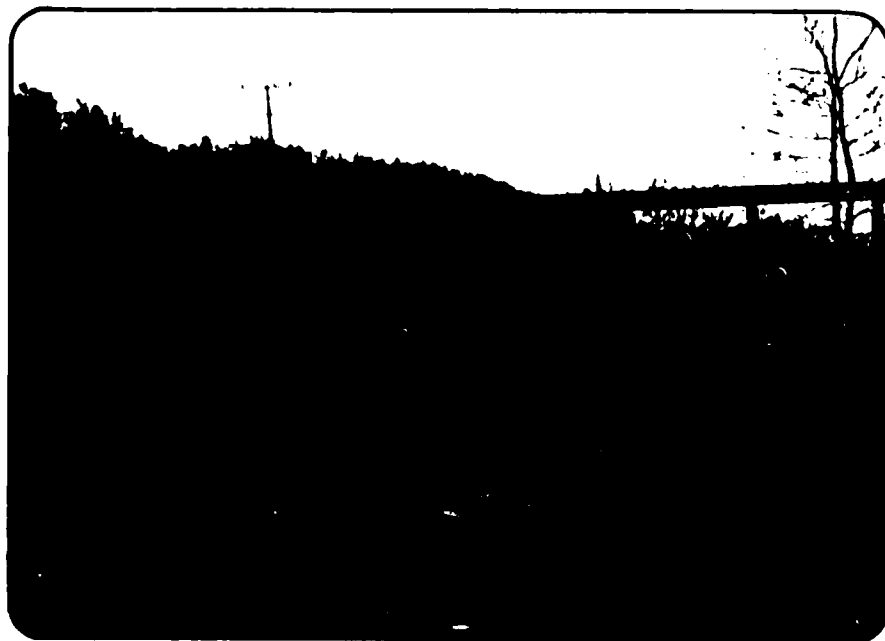
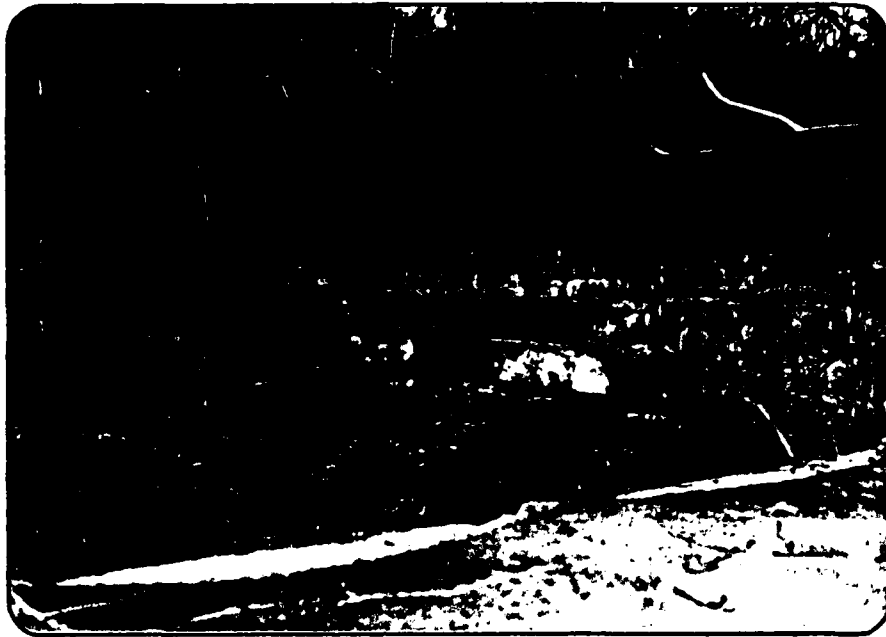
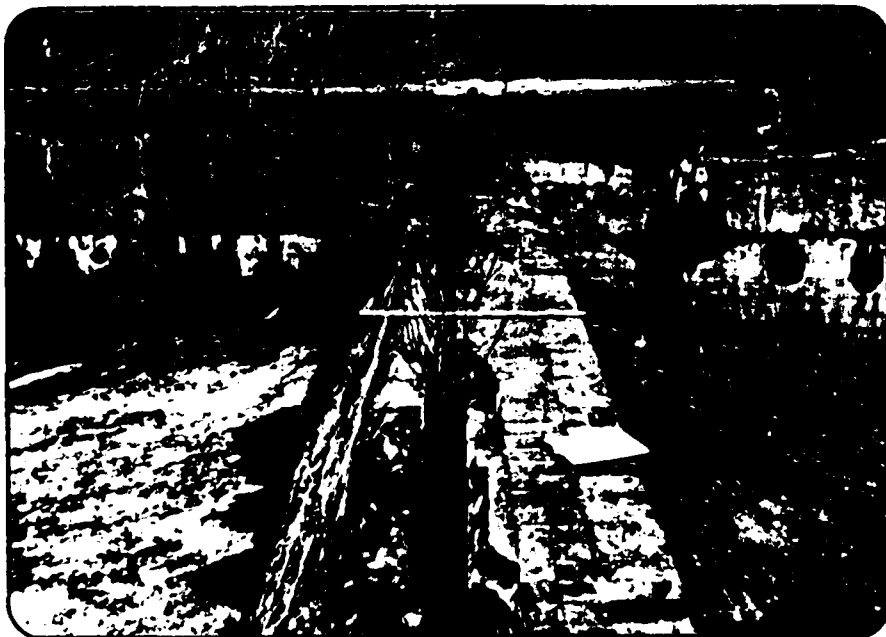


PHOTO 2. View of the Downstream Slope from the Right Downstream Toe

COAL DAM



**PHOTO 3. View of the Upstream Side of the Spillway Weir from the Right
Spillway Training Wall**



**PHOTO 4. View Looking Across the Spillway Weir from the
Left Side of the Weir**

COAL DAM



**PHOTO 5. View Looking Upstream at the Downstream Side
of the Spillway Weir**



PHOTO 6. View Looking Downstream Along the Spillway Discharge Channel

COAL DAM

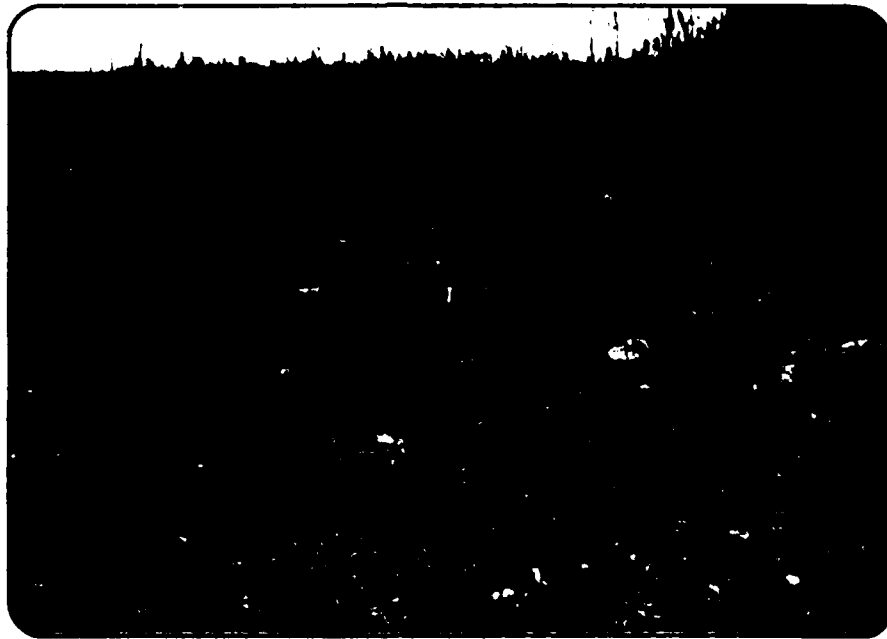


PHOTO 7. View Looking Upstream at the Outlet Location and Abandoned Valve House

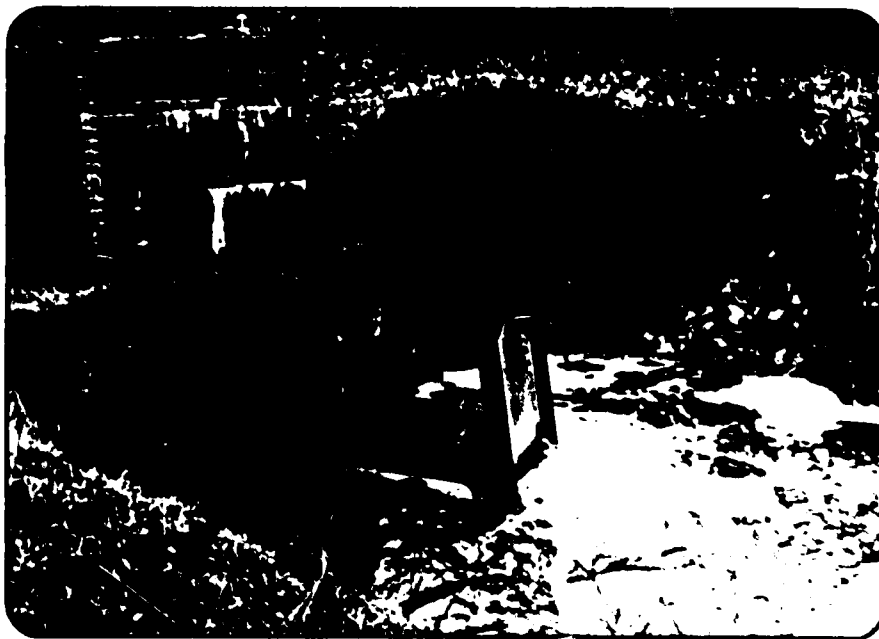


PHOTO 8. Close-up View of the Discharge End of the Outlet Conduit with Slide Gate (Note erosion in background of photo)

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject COAL DAM S.O. No. _____
APPENDIX D - HYDROLOGIC AND Sheet No. _____ of _____
HYDRAULIC CALCULATIONS Drawing No. _____
Computed by _____ Checked by _____ Date _____

<u>SUBJECT</u>	<u>PAGE</u>
PREFACE	i
HYDROLOGY AND HYDRAULIC DATA BASE	1
HYDRAULIC DATA	2
DRAINAGE AREA MAP	3
TOP OF DAM PROFILE AND TYPICAL CROSS-SECTION	4
SPILLWAY RATING CURVE	5
SPILLWAY CAPACITY	7
HEC-1 ANALYSIS	8

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic determinations presented in this Phase I Inspection Report are based on the use of a Snyder's unit hydrograph developed by the U.S. Army Corps of Engineers. Due to the limited number of gaging stations available in this hydrologic region and the wide variations of watershed slopes, the Snyder's coefficients may yield results of limited accuracy for this watershed. As directed however, a further refinement of these coefficients is beyond the scope of this Phase I Investigation.

In addition, the conclusions presented pertain to present conditions, and the effect of future development on the hydrology has not been considered.

HYDROLOGY AND HYDRAULIC ANALYSIS DATA BASE

NAME OF DAM: COAL DAM

PROBABLE MAXIMUM PRECIPITATION (PMP) = 24.0 INCHES/24 HOURS⁽¹⁾

STATION	1	2	3	4	5
Station Description	COAL DAM				
Drainage Area (square miles)	0.29				
Cumulative Drainage Area (square miles)	0.29				
Adjustment of PMP for Drainage Area (%) ⁽²⁾	Zone 7				
6 Hours	102				
12 Hours	120				
24 Hours	130				
48 Hours	140				
72 Hours	--				
Snyder Hydrograph Parameters					
Zone ⁽³⁾	29				
C_p/C_t ⁽⁴⁾	0.50/1.6				
L (miles) ⁽⁵⁾	0.95				
L_{ca} (miles) ⁽⁵⁾	0.38				
$t_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	1.18				
Spillway Data					
Crest Length (ft)	40.5				
Freeboard (ft)	0.82				
Discharge Coefficient	(Rating curve developed on sheet 5)				
Exponent					

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.

L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject COAL DAM S.O. No. _____
HYDRAULIC DATA Sheet No. 2 of 12
Drawing No. _____
Computed by WNL Checked by WLS Date 3-31-80

STORAGE COMPUTATIONS :

ELEVATION VS. AREA DATA (MEASURED FROM QUADS) :

<u>ELEVATION, FT</u>	<u>AREA, ACRES</u>
952.0	2.45
960.0	4.90
980.0	11.33

NOTE : NORMAL POOL ELEVATION
ASSUMED TO BE
952.0 FT

NORMAL POOL STORAGE :

$$\text{STORAGE VOLUME} = V_{NP} = \frac{h}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$$

h = AVERAGE DEPTH = 13 FT

(ESTIMATED FROM MEASUREMENTS
MADE DURING INSPECTION)

A_1 = SURFACE AREA OF NORMAL POOL

A_1 = 2.45 ACRES

A_2 = SURFACE AREA OF RESERVOIR BOTTOM

(ESTIMATED FROM RESERVOIR SLOPES
AND DEPTH)

A_2 = 1.76 ACRES

$$V_{NP} = \frac{13}{3} (2.45 + 1.76 + \sqrt{(1.76)(2.45)})$$

$$V_{NP} = 27.2 \text{ AC-FT}$$

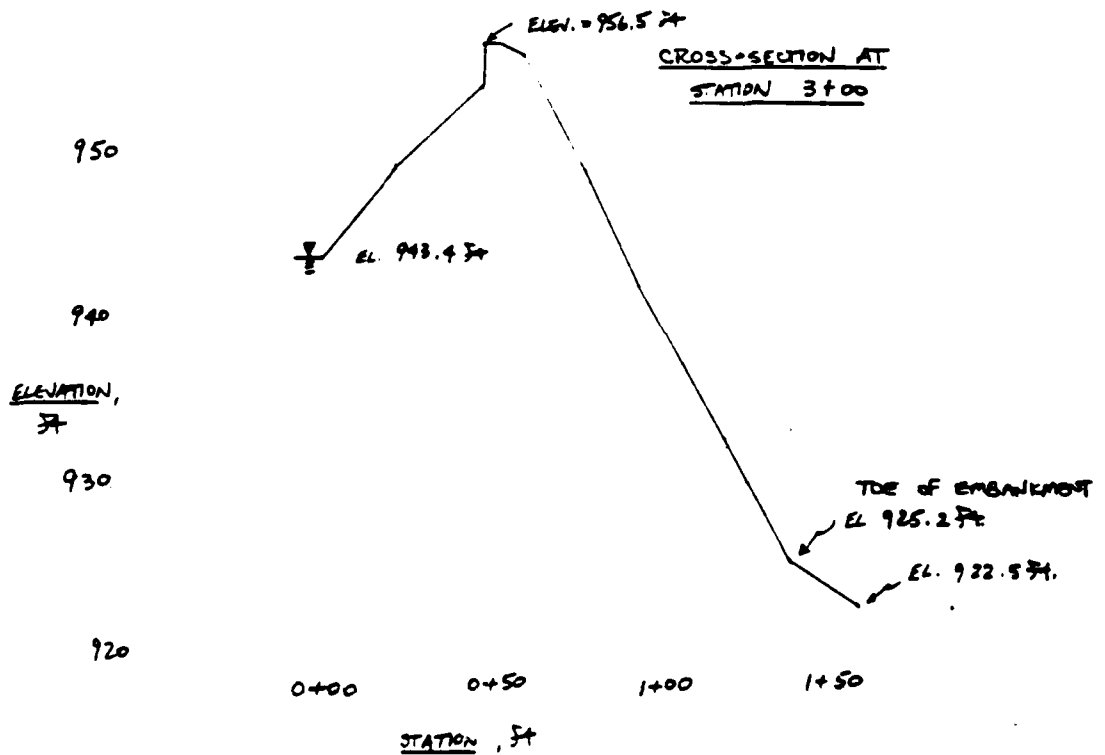
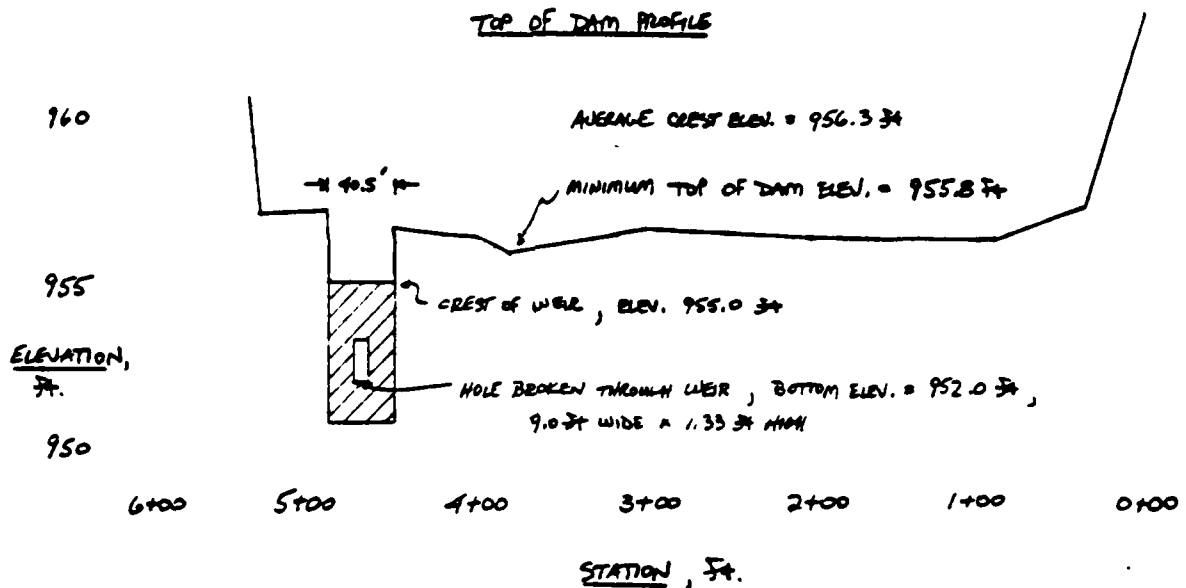
$$\text{TOP OF DAM STORAGE} = 39.0 \text{ AC-FT} \quad (\text{FROM HEC-1 ANALYSIS})$$



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THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject: COAL DAM S.O. No. _____
TOP OF DAM PROFILE AND Sheet No. 4 of 12
TYPICAL CROSS SECTION Drawing No. _____
Computed by WLS Checked by WDL Date 3-17-80

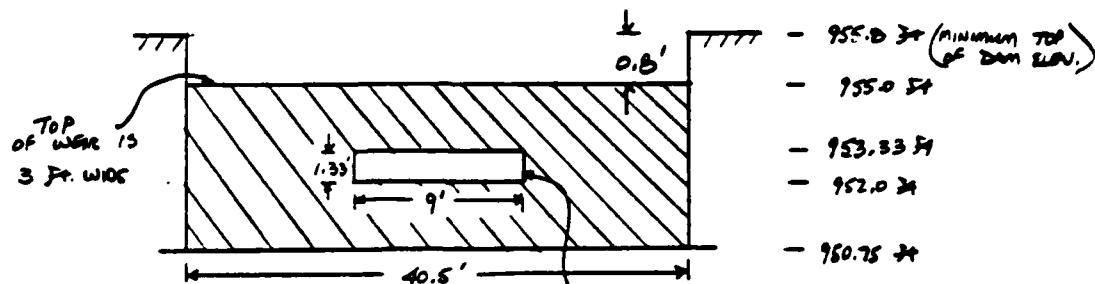


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Beaver, Pa. 15009

Subject COAL DAM S.O. No. _____
SPILLWAY RATING CURVE Sheet No. 5 of 12
DATA Drawing No. _____
Computed by WDL Checked by STQ Date 3-17-80

FRONT VIEW OF WEIR



NOT TO SCALE

HOLE BROKEN THROUGH WEIR, 2.6 ft DEEP

WEIR FLOW THROUGH OPENING:

$$Q = CLH^{3/2}$$

$$L = 9.0 \text{ ft}$$

$$C = 2.64 \quad (\text{FROM BRATER \& KING, HANDBOOK OF HYDRAULICS, 7. 5-40})$$

ORIFICE FLOW:

$$Q = CA\sqrt{2gh}$$

$$A = 11.97 \text{ ft}^2$$

$$g = 32.2 \text{ ft/sec}^2$$

$$h = \text{HEAD MEASURED TO CENTER OF ORIFICE}$$

$$C = 0.60 \quad (\text{FROM BRATER AND KING, HANDBOOK OF HYDRAULICS, 7. 4-35})$$

FLOW OVER TOP OF WEIR:

$$Q = CLH^{3/2}$$

$$L = 40.5 \text{ ft}$$

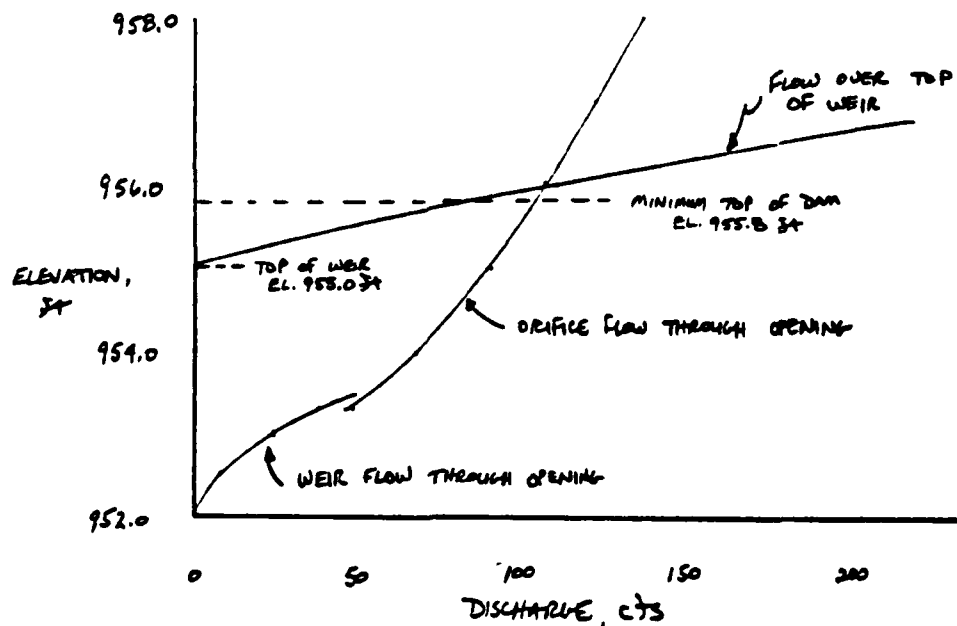
$$C = 2.67 \quad (\text{FROM BRATER \& KING, HANDBOOK OF HYDRAULICS, 7. 5-70})$$

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject COAL DAM S.O. No. _____
SPILLWAY RATING CURVE Sheet No. 6 of 12
Drawing No. _____
Computed by WDL Checked by JAG Date 3-17-80

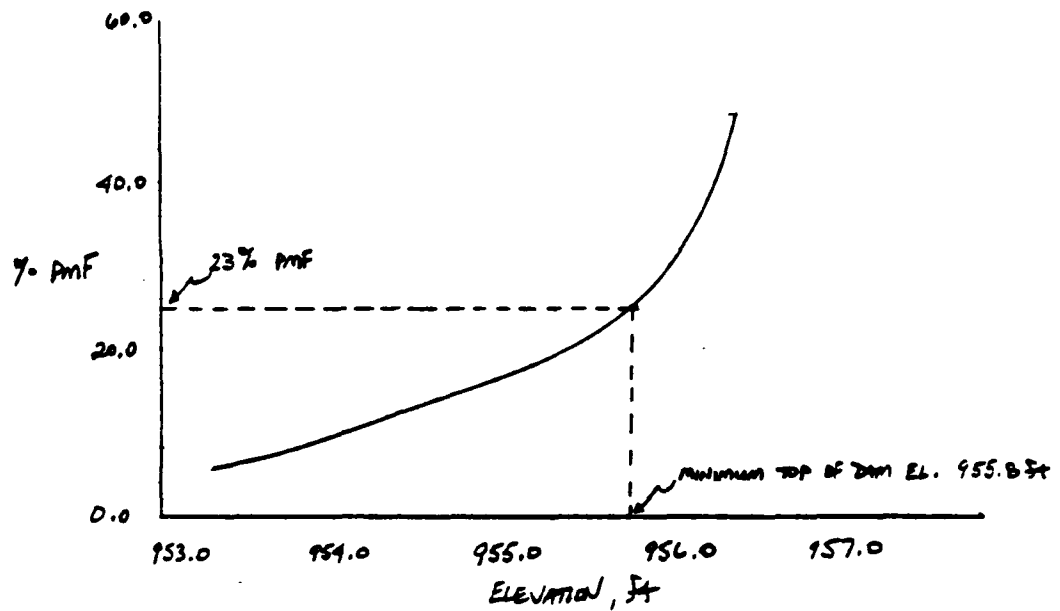
ELEVATION, ft	TOTAL DISCHARGE, cfs	REMARKS
952.0	0.0	↑
952.5	8.40	WEIR FLOW THROUGH OPENING
953.0	23.76	↓
953.33	36.44	↓
954.0	66.72	ORIFICE FLOW THROUGH OPENING
955.0	88.17	↓
956.0	213.47	ORIFICE FLOW + FLOW OVER CREST OF WEIR
958.0	695.08	↓



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject COAL DAM S.O. No. _____
SPILLWAY CAPACITY ANALYSIS Sheet No. 7 of 12
Drawing No. _____
Computed by WDL Checked by _____ Date 2-17-80



SPILLWAY CAPACITY = 188 CFS AT EL. 955.8 ft

FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAY SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79
 WRJ JDATE 04 JUN 79

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS

HYDROLOGIC AND HYDRAULIC ANALYSES OF LUAL DAM

UNIT HYDROGRAPH BY SNYDER'S METHOD

0 0 0 0 0 -4 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

30 0 0

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 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAN SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79
 48J UPDATE 04 JUN 79

RUN DATE 04/01/80
 TIME 12.02

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
 HYDROLOGIC AND HYDRAULIC ANALYSES OF LOCAL DAM
 UNIT HYDROGRAPH BY SNEYDE'S METHOD

JOB SPECIFICATION									
NO	KHR	NTIN	IDAY	INR	INER	MLERC	IPLT	IPRT	NSIAN
300	0	30	0	0	0	0	0	-4	0
		JUPER	5	0	0	0	0		

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLAN= 1 NRTIO= 4 LRTIO= 1

RTIO= 0.50 0.25 0.10 0.05

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO DAM

ISTAQ	ICOMP	IECON	ITAPL	JPLT	JPRI	INAME	ISIAUE	IAUTU
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INVOG	IUNG	TARLA	SNAP	TRSDA	TRSPC	KATIO	ISNUM	ISAME	LOCAL
1	1	0.29	0.0	0.29	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	24.00	102.00	120.00	130.00	140.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA										
LAOPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRIL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

IP= 1.18 CP=0.50 NIA= 0

RECESSION DATA

STRIO= -1.50 UNCSN= -0.05 RTIOK= 2.00

UNIT HYDROGRAPH 19 END-OF-PERIOD ORDINATES, LAG= 1.18 HOURS, CP= 0.50 VOL= 1.00

19.	59.	74.	59.	43.	32.	23.	17.	1.	1.	9.
7.	5.	4.	3.	2.	1.	1.	1.	1.	1.	1.

END-OF-PERIOD FLOW

0

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO	RATIOS APPLIED TO FLOWS			
					0.50	RATIO 2 0.25	RATIO 3 0.10	RATIO 4 0.05
HYDROGRAPH AT	1	0.29 (0.75)	1	40%	202%	81%	40%	
			(11.44%	5.72%	2.29%	1.14%	
ROUTED TO	2	0.29 (0.75)	1	40%	193%	69%	34%	
	((11.54%	5.45%	1.95%	0.98%	

SUMMARY OF DAM SAFETY ANALYSIS

PLAY 1									
ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM			
STORAGE		952.00		952.00		952.00			
OUTFLOW		27.		27.		33.			
		0.		0.		100.			
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS		
0.50	956.42	0.64	41.	408.	4.00	41.00	0.0		
0.25	952.83	0.03	39.	113.	0.50	41.50	0.0		
0.10	954.11	0.0	33.	67.	0.0	42.00	0.0		
0.05	953.28	0.0	31.	34.	0.0	42.00	0.0		

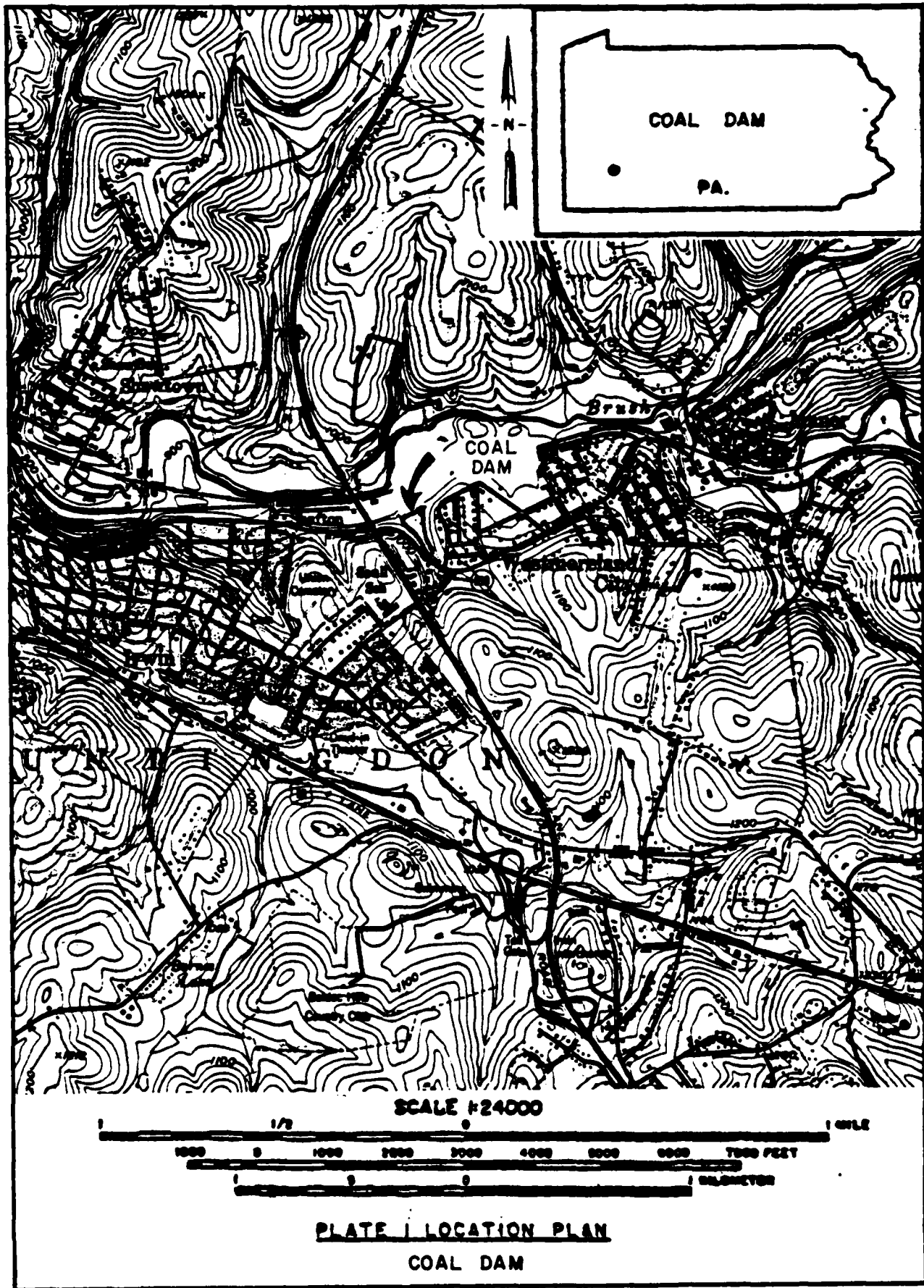
APPENDIX E

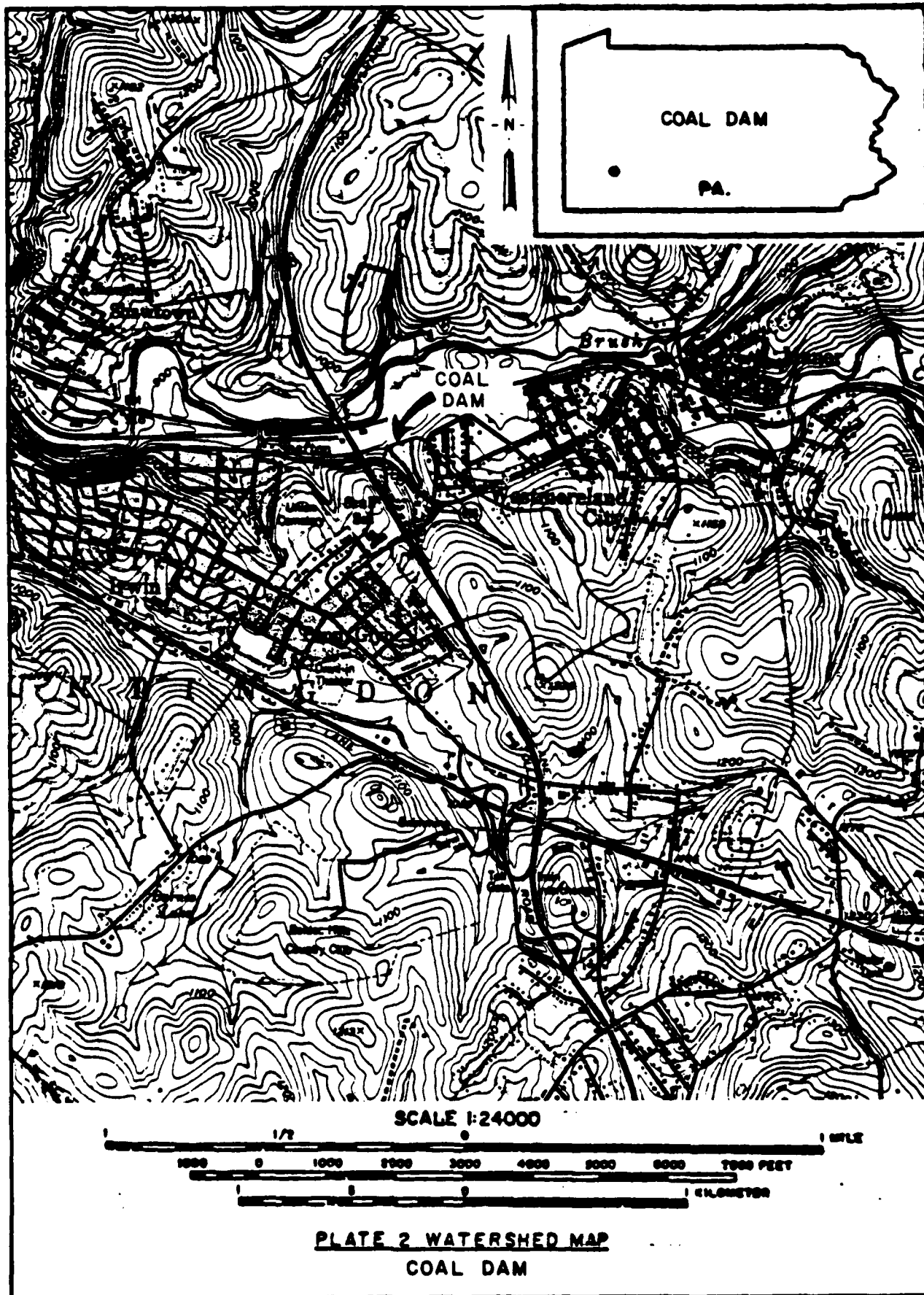
PLATES

CONTENTS

Plate 1 - Location Plan

Plate 2 - Watershed Map





APPENDIX F

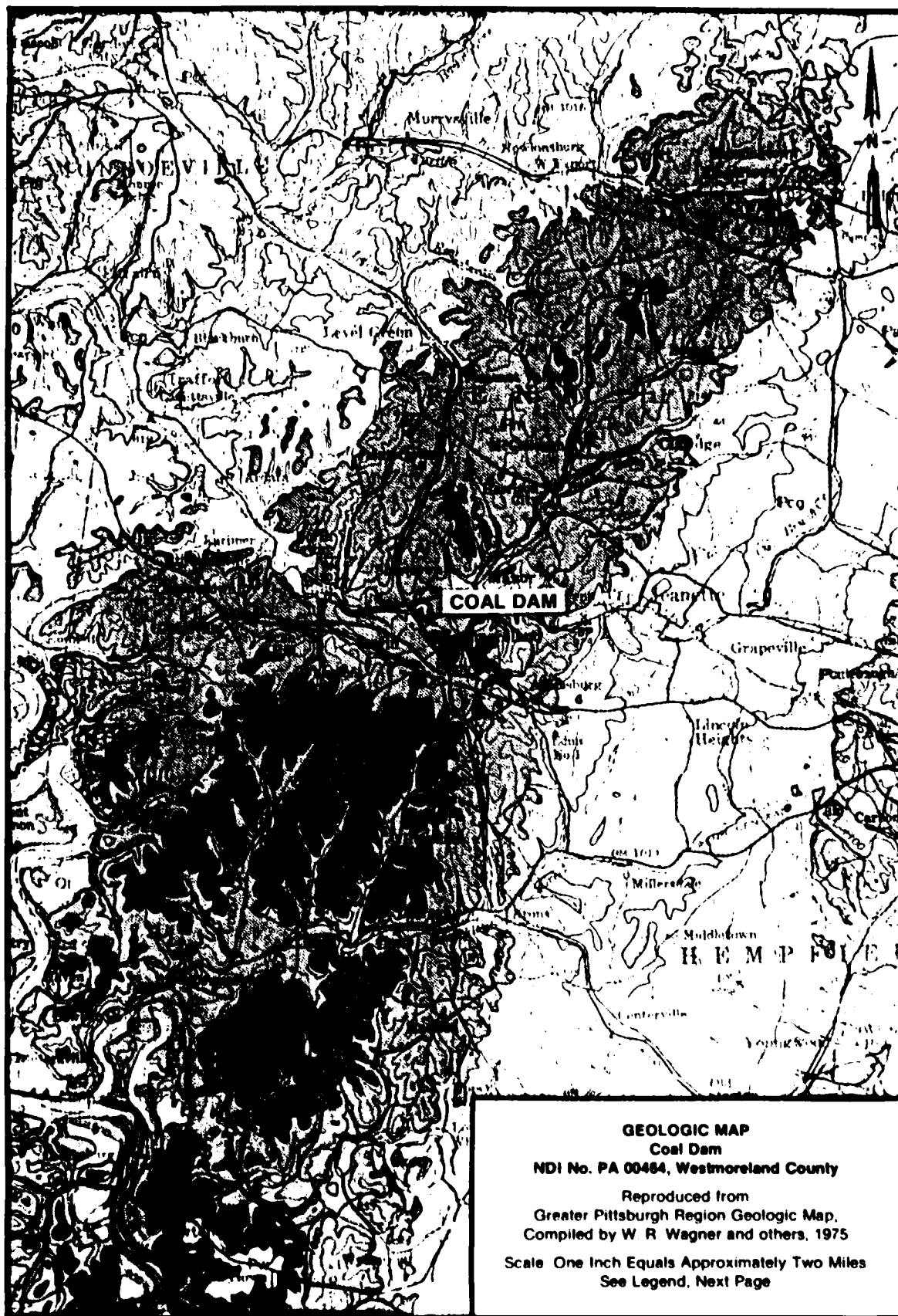
REGIONAL GEOLOGY

COAL DAM
NDI No. PA 00464, PennDER No. 65-45

REGIONAL GEOLOGY

Coal Dam is located in an unglaciated section of the Appalachian Plateaus Physiographic Province. Bedrock units below the dam are members of the Monongahela Group, Pennsylvanian System. These members consist of cyclic sequences of shale, limestone, sandstone, and coal.

Located approximately 130 feet (Elevation 790 feet M.S.L.) beneath the dam site is the Pittsburgh coal which has been mined by the Westmoreland Coal Company's Biddle Mine (abandoned).



GEOLOGY MAP LEGEND

GROUP FORMATION

DESCRIPTION

Alluvium		Qt	Sand, gravel, clay.
Terrace deposits			Sand, clay, gravel on terraces above present rivers; includes Carmichaels Formation.
DUNKARD	Greene		Cyclic sequences of sandstone, shale, red beds, thin limestones and coals.
	Washington	Pw	Cyclic sequences of sandstone, shale, limestone, and coal; contains Washington coal bed at base.
	Waynesburg		Cyclic sequences of sandstone, shale, limestone and coal; contains Waynesburg coal bed at base.
MONONGAHELA		Pm	Cyclic sequences of shale, limestone, sandstone and coal; contains Pittsburgh coal bed at base.
P. CONEMAUGH	Casselman	Fcc	Cyclic sequence of sandstone, shale, red beds and thin limestone and coal.
	Ames		
	Glenshaw	Pcq	Cyclic sequences of sandstone, shale, red beds and thin limestone and coal; several fossiliferous limestone; Ames limestone bed at top.
ALLEGHENY	Vanport	Pa	Cyclic sequences of shale, sandstone, limestone, and coal; contains Brookville coal at base and Upper Freeport coal at top; within group are the commercial Vanport limestone and Kittanning and Clarion coals.
		Pa	
POTTSVILLE			Sandstone and shale, contains some conglomerate and locally mineable coal.
Mauch Chunk			Red and green shale with some sandstone; contains Wymys Gap and Loyalhanna limestones.
Pocono			Sandstone and shale with Burgoon sandstone at top.

DA
FILM

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